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MEMORANDUM

To:	**US 85 Access Committee Members**	Date:	October 9, 2008
Copy To:	Gloria Hice-Idler, CDOT Region 4 Bill Sterling, City of Greeley Joel Hamasath, City of Greeley Bill Andrews, City of Greeley Fred Jones, City of Greeley Derek Glosson, City of Greeley Jack Towle, Leprino Foods Scott Savage, Leprino Foods Phil Mares, Leprino Foods Jon Alby, Leprino Foods Duane Jansen, Martin/Martin	From: Project No.: Project Title:	Aaron S. Heumann, P.E., PTOE Craig MacPhee, P.E. 20712.C.75 Leprino Foods Greeley, CO Plant

RE: Leprino Foods – Proposed Amendment to US 85 Access Control Plan

EXECUTIVE SUMMARY

With the assistance and support of the City of Greeley, Leprino Foods is requesting that the US 85 Access Control Plan be amended to allow Leprino Foods to fund the installation of a traffic signal and any necessary improvements to provide the adequate auxiliary lanes at the US 85 & 13th Street intersection. Each of the twelve US 85 Access Control Agency Policy Committee Members is requested to provide a YES vote in favor of accepting an amendment to the access control plan.

An approval by the Committee would allow the project team to continue to the next step of preparing a CDOT access permit and a comprehensive traffic impact study to determine if the proposed Leprino Foods Plant project will go forward. The following information is offered in support of the proposed amendment. As part of a preliminary traffic analysis to determine the safest and most direct access for trucks associated with the proposed Leprino Foods cheese and whey manufacturing and processing plant in the City of Greeley, the following summary applies.

1. A cheese plant is proposed to be constructed and operated by Leprino Foods within the City of Greeley, east of US 85 and adjacent to and west of Ash Avenue between 8th Street and 16th Street. The plant will be built in four phases with the first two phases completed concurrently prior to opening day and the final two phases finished as soon as three years after the plant opening.
2. Access to the site will be separated into two locations. A service access for truck traffic associated with raw milk deliveries, supplies and finished goods distribution will be provided as an extension of 13th Street at 1st Avenue on the west side of the property. Given the nature of the vehicles at this access which require large radii for turns and a roadway section to withstand the higher structural loads, 13th Street is anticipated to service as direct access for trucks to US 85. An employee access to a 300 stall parking lot will be located along Ash Avenue just north of 16th Street along the east side of the property and will primarily serve passenger cars.

3. Traffic counts were collected at six intersections along US 85 Bypass during the AM and PM peak hours including 22nd Street, 18th Street, 16th Street, 13th Street, 8th Street, and 5th Street. Daily counts were collected at the intersection of US 85 & 13th Street. A vehicle classification count was conducted along US 85, which showed between 10 and 15 percent of the traffic on this corridor is made up of heavy vehicles including busses and various sized trucks.
4. Trips anticipated to be generated by the proposed plant were developed based on data provided for a similar plant located in California. In total, 600 truck trips and 786 employee car trips are anticipated on an average weekday. Truck traffic to and from the site will use US 85 with a vast majority oriented to/from the south.
5. Warrants for signalization were evaluated for the intersection of US 85 & 13th Street. The intersection meets Warrants 2 (Four Hour) and 3 (Peak Hour) for existing and future conditions. Warrant 1 (Eight Hour) may be met for various conditions depending on the analysis method applied. Warrant 7 (Crash Experience) is met for the existing and two of the future with project conditions analyzed.
6. Level of service calculations were performed for the six intersections along the US 85 corridor for the existing conditions and the future with project conditions both with a right-in/right-out configuration and a full-movement signalized configuration at 13th Street. The intersection capacity analysis indicates that the City of Greeley and CDOT standards for level of service are satisfied and that there will be no significant decrease in the operations at the individual signalized intersections along the US 85 corridor as a result of addition of a traffic signal at 13th Street.
7. Signal progression analysis was performed for the existing conditions with the signal timings and volumes previously implemented in 2005 for the US 85 corridor, with the recent volumes collected in September 2008 and the existing signal timing, and with the recent volumes and optimized offset timings. Future progression was measured for both the right-in/right-out configuration and a full-movement signalized configuration at 13th Street. The analysis results identified an improvement over both the existing operations along the US 85 corridor between 5th Street and 22nd Street and compared to the right-in/right-out configuration with the addition of a traffic signal at 13th Street. The primary reason for the improvement with the addition of a 13th Street traffic signal compared to the existing conditions is a re-evaluation of the offsets. The primary reason for the improved operations compared to a right-in/right-out configuration is that the 16th Street intersection is currently the most restrictive location along the corridor and, without the traffic signal at 13th Street, more Leprino Food Plant project-generated traffic would be forced to use 16th Street as the only reasonable alternative to 13th Street.

INTRODUCTION

Leprino Foods is planning to build a cheese plant in the City of Greeley, east of US 85 between 16th Street and the Poudre River. A vicinity map is shown in **Exhibit 1**, which is attached. The site has historically been the location of a sugar beet plant, which will be demolished and removed as a part of this project.

US 85 will be the primary route for trucks delivering raw milk and supplies and for finished goods distribution. US 85 in the immediate vicinity is a four-lane separated highway with a coordinated signal network extending from 5th Street north of the site to 22nd Street south of the site. Along this stretch of US 85, five signals are included within the coordinated system, specifically at 5th Street, 8th Street, 16th Street, 18th Street and 22nd Street. Access for trucks related to the Leprino Foods facility to US 85 is proposed via 13th Street, which is currently stop controlled on 13th Street.

The purpose of this memorandum is to assess the need and impacts of installing and implementing a traffic signal on US 85 at 13th Street to accommodate the vehicular traffic. This intersection was proposed to become a right-in/right-out access in the *US 85 Access Control Plan* (December 1999). However, this access configuration has not been implemented in the ten years since the access control plan was completed. Installing a signal at the 13th Street & US 85 intersection requires an amendment to the *US 85 Access Control Plan* and acceptance from a majority (a minimum eight of the twelve) of the agencies associated with the corridor.

As this memo will show, an amendment to the *US 85 Access Control Plan* to allow the installation of a traffic signal at the US 85 & 13th Street intersection is not only justified by analytical results but essential to ensure a safe and efficient access for the proposed Leprino Foods service vehicles and in the best interest of the US 85 corridor between 5th Street and 22nd Street.

PROJECT DESCRIPTION

Leprino Foods is a world leader in quality cheese production and one of the largest producers of cheese in the United States. They have plants in several locations throughout the United States including California, Colorado, Michigan, Nebraska, New Mexico, and New York. The location of the proposed plant in Greeley, Colorado was chosen based on the property's geographic proximity to a sustainable milk supply and Denver for distribution of finished goods.

Leprino Foods has purchased and is proposing construction of a new cheese and whey manufacturing and processing facility on the 94.3 acre property surrounded by 1st Avenue to the west, 16th Street to the south, Ash Avenue to the east and 8th Street to the north. The proposed site plan is shown in the attached **Exhibit 2**. This property was previously the site of Great Western Sugar that operated until 2005 and is currently in the process of being demolished. The Leprino Foods plant, when ultimately completed in as soon as 3 years, would be 870,000 square feet (KSF) and employ between 400 and 500 workers. The facility is proposed to be developed through four phases of construction. The first two phases would be completed successively and include 550 KSF and then 160 KSF of building space, respectively, and 250 parking spaces for employees. The final two phases would be constructed as necessary over the next 10 years and include 60 KSF of additional building space and then add a final 100 KSF to the facility as part of phases 3 and 4, respectively. In addition, the employee parking lot could be expanded to include an additional 150 parking spaces for a total of 400 spaces.

The site is proposed to provide two separate accesses for employees and trucks. The employee access will be located along Ash Avenue north of 16th Street. The service vehicle access for raw milk delivery trucks, supply trucks, finished goods shipping trucks and any other larger vehicles will be accommodated at an extension of 13th Street along 1st Avenue. The site layout that has been developed and proposed to provide the most efficient and cost effective design based on the constraints of the property. Many site limitations were encountered that dictated the configuration of the buildings and operations and, as a result, established the location of the vehicle accesses. Some of the key elements directing the design of the site included the following:

- The utility connection routes and orientation for servicing the proposed facility. For one, a substantial power line is located along Ash Avenue, dictating the orientation of the plant.
- The presence of existing gas wells requiring the establishment of set distance separations from particular operations of the plant to accommodate the adequate blast zones.
- The unusual grading and presence of buried materials resulting in drainage and potential flooding issues throughout the site, which dictates where certain functions such as the loading docks could be located.
- The need to avoid disturbing or in any way adversely impacting the Poudre River, which runs through the northern portion of the property.
- The need to separate the large disparity between the various vehicle types accessing the facility. Vehicle types will range from passenger cars for employees to almost 80-foot long tanker trucks for daily raw milk deliveries. Therefore, as with other Leprino Foods plants, separation of the employees' vehicles from the prevalent truck activity is essential.
- The truck weighing scales require the ability to queue trucks on site and thus need to be oriented accordingly

Not only does the necessary layout of the site in response to the physical constraints require the access driveways to be located as shown on the site plan, but safety, minimizing impact to the surrounding roadway network, and efficiency of operations dictate the layout as well. The one block along 13th Street between US 85 and 1st Avenue provides the most direct access between the service entrance/exit for the property and US 85. As direct an access as possible to US 85 is critical for ensuring safe and efficient operations. With the number and size of the trucks accessing the property, the more lower class of roadways and turns on these roadways required of the large trucks increases the designed turn radii, the need for extended queuing areas, the potential for damage to these ill-equipped streets, and exposure of passenger cars to the turns of these large, heavy vehicles. The trucks that will be serving the plant are intended and expected by other drivers to be driven on higher classified roadways, which are designed and built to accommodate the turns of larger vehicles and to carry heavier loads. Exposure of passenger cars to the regular procession of trucks on roadways such as 1st Avenue and 16th Street would not be preferred to the limited traffic operating on 13th Street.

DATA COLLECTION

In order to determine the existing conditions and traffic issues and to conduct analysis at the US 85 & 13th Street intersection and along the US 85 corridor, roadway and intersection geometry was noted, traffic volumes were collected, signal timing information and crash history were obtained, and general observations were made in the field.

Roadway & Intersection Geometry

Geometric configuration information was collected along US 85 & 13th Street. US 85 is a divided highway with two northbound and two southbound lanes in the vicinity of 13th Street. An exclusive lane is provided for left-turn movements at 13th Street and a southbound right-turn lane is also present. The roadway is signed at 45 miles per hour (mph). 13th Street is stop controlled at US 85. The eastbound approach has two through lanes with left-turns made from the inside lane. Right turns on the approach are made from a short exclusive lane into a southbound acceleration lane on US 85. The westbound approach is striped as one very wide lane, but typically functions as two lanes for passenger cars. The extra wide approach and turning radii along 13th Street are presumed to be present to accommodate the high amount of truck traffic on this approach, as shown in the picture from Google Maps to the right.

Traffic Volumes

The following traffic volume information was gathered at the US 85 & 13th Street intersection on September 4, 2008 by All Traffic Data, Inc. under the direction of Martin/Martin.

- Continuous directional traffic counts along the two US 85 approaches to the 13th Street intersection over a 24-hour period.
- Continuous directional traffic counts along the 13th Street approaches to the US 85 intersection over a 24-hour period.
- Intersection turning movement counts via video tape of the intersection during the morning peak hours of 7:00 to 9:00 AM and the evening peak hours of 4:00 to 6:00 PM.
- Vehicle classification counts along US 85 in the vicinity of the 13th Street intersection.

The volume data is summarized in **Table 1** and **Table 2**. As indicated in the tables, approximately 25,400 trips utilize the US 85 & 13th Street intersection on a typical day of which just over 6.5 percent occurs during the AM peak hour and 8.1 percent occurs during the PM peak hour.

Table 1. US 85 & 13th Street Intersection Turning Movement Counts

Time Period	Eastbound			Westbound			Northbound			Southbound			Intersection Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM Peak Hour *7:15 - 8:15 AM*	6	18	98	2	15	63	134	598	6	31	470	18	1,459
PM Peak Hour *4:15 - 5:15 PM*	7	21	149	7	23	65	139	496	7	36	677	18	1,645

Source: All Traffic Data collected on September 4, 2008

The distribution of turn movements counted during the four hours of morning and evening peak hour conditions along the eastbound and westbound approaches for 13th Street were utilized to separate out the right-turn volumes from the left-turn and through movement volumes for the other hours of data collection for the day.

Table 2. US 85 & 13th Street Intersection Daily Volume Counts

Hour Beginning	Eastbound Approach			Westbound Approach			Northbound Approach	Southbound Approach	Intersection Total
	LT & TH	RT	Total	LT & TH	RT	Total			
0:00	5	21	26	2	8	10	77	158	271
1:00	2	6	8	0	1	1	46	62	117
2:00	2	8	10	0	1	1	46	62	119
3:00	2	8	10	1	4	5	65	70	150
4:00	5	19	24	1	2	3	123	90	240
5:00	18	70	88	6	19	25	499	351	963
6:00	25	99	124	9	29	38	700	577	1,439
7:00	28	114	142	19	57	76	798	658	**1,674**
8:00	26	106	132	21	65	86	608	688	1,514
9:00	28	112	140	21	63	84	586	653	1,463
10:00	28	114	142	15	47	62	542	604	1,350
11:00	28	114	142	15	47	62	526	664	1,394
12:00	35	141	176	19	59	78	605	692	1,551
13:00	40	160	200	22	68	90	710	729	1,729
14:00	31	126	157	22	68	90	740	727	1,714
15:00	36	146	182	20	62	82	744	842	1,850
16:00	46	183	229	22	66	88	745	995	**2,057**
17:00	41	166	207	21	65	86	669	914	1,876
18:00	29	115	144	13	39	52	436	642	1,274
19:00	27	106	133	8	24	32	336	449	950
20:00	20	80	100	4	14	18	300	288	706
21:00	12	48	60	4	11	15	202	211	488
22:00	8	34	42	2	6	8	114	150	314
23:00	4	18	22	1	2	3	76	94	195
Daily Total	**526**	**2,114**	**2,640**	**268**	**827**	**1,095**	**10,293**	**11,370**	**25,398**

Source: All Traffic Data collected on September 4, 2008.

Additionally, turning movement counts were collected at several intersections along the US 85 corridor on September 4, 2008 from 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM. These intersections include 5th Street, 8th Street, 16th Street, 18th Street and 22nd Street. The AM and PM peak hours from these counts are shown in the attached **Exhibit 3**.

Hourly volumes were also collected over a 24-hour period along US 85 during the weekend on September 6, 2008. The counts indicated a reduction in volumes compared to the weekday data of almost 30 percent. Consequently, all of the analysis conducted for the US 85 & 13th Street intersection was completed for the weekday conditions only.

The vehicle classification count along US 85 indicated that 13.5 percent of the northbound traffic and 14.6 percent of the southbound traffic over the course of a day consists of heavy vehicles, which includes trucks and buses. These percentages are closely represented during the AM and PM peak hours also.

Signal Timing

Signal plans were developed by PBS&J at the direction of CDOT along the US 85 corridor between 5th Street and 22nd Street and documented in the *US 85 Bypass Signal Coordination Study Final Report* in August 2005. Four different timing plans were prepared including for the AM peak period, off-peak period, PM peak period and weekend. The signal timing was developed in a Synchro, Version 6 model, which was obtained for purposes of the analysis prepared in this study.

Accident Data

The City of Greeley staff provided the available accident reports for the US 85 & 13th Street intersection over the last three years. Based on the data, there were a total of ten accidents reported at or near the intersection, with two of those accidents occurring in 2007, one in 2006 and seven in 2005. When compared to the average daily traffic (ADT) count of almost 25,400 vehicles, the accident rate is 0.36 accidents per million entering vehicles (MEV) over this three year period (10 accidents in three years for an intersection ADT of 25,398 applied over 365 days). This rate is well below 1.0, typically looked upon as one of the thresholds for considering the accidents at an intersection to be greater than average and criteria for considering mitigation measures to correct any problems.

TRIP GENERATION

The Leprino Foods plant that is proposed for Greeley, Colorado is similar in nature to an existing Leprino plant located in Lemoore, California. Typically, trip generation for proposed uses within a development is derived by utilizing *Trip Generation, Seventh Edition* (2003), published by the Institute of Transportation Engineers (ITE). However, there is no comparable land use included within the *Trip Generation* document for a Leprino Foods cheese plant. Since the California plant is comparable and Leprino Foods keeps records of traffic into and out of their plant, this information was utilized in estimating the trips associated with the proposed Greeley site.

The Greeley plant will operate 24 hours a day, 7 days a week just as the Lemoore plant does. The Lemoore plant processes approximately 6.0 million pounds of milk per day. Ultimately, the Greeley plant will process 10.0 million pounds per day, but in the near future will only process 5.5 million pounds per day. Therefore, the Lemoore plant traffic numbers were adjusted to 90% of the original to account for the lower production.

Traffic to and from the plant will be comprised of a variety of trips and vehicles. Employees will travel to and from the site predominantly in passenger car vehicles and will park on the east side of the site accessed from Ash Avenue. All truck traffic will enter and exit on the west side of the site, which will be constructed as an extension to 13th Street, with the access located along 1st Avenue. Heavy vehicle traffic will be made up of raw milk delivery trucks, supply trucks, and finished goods trucks. The following table shows a summary of the anticipated trips associated with the site broken down by vehicle type and use for a typical 24-hour period.

Table 3. Phase 1 & 2 Trip Generation Summary

Hour Beginning	Raw Milk Trucks	Supply & Finished Goods Trucks	Total Trucks	Employee Cars	Total Generated
0:00	0	0	**0**	15	15
1:00	0	0	**0**	11	11
2:00	0	0	**0**	17	17
3:00	0	0	**0**	18	18
4:00	4	2	**6**	9	15
5:00	4	2	**6**	55	61
6:00	8	4	**12**	84	96
7:00	8	4	**12**	54	66
8:00	15	9	**24**	24	48
9:00	15	9	**24**	14	38
10:00	15	9	**24**	17	41
11:00	15	9	**24**	22	46
12:00	15	9	**24**	29	53
13:00	61	35	**96**	54	150
14:00	61	35	**96**	66	162
15:00	30	18	**48**	58	106
16:00	61	35	**96**	33	129
17:00	61	35	**96**	20	116
18:00	4	2	**6**	23	29
19:00	4	2	**6**	18	24
20:00	0	0	**0**	8	8
21:00	0	0	**0**	48	48
22:00	0	0	**0**	57	57
23:00	0	0	**0**	32	32
Daily Total	**381**	**219**	**600**	**786**	**1,386**

Source: Leprino Foods based on Lemoore, CA Plant.

Ultimate build-out of the plant will be 10 million pounds of milk per day which will result in less than twice as many daily trips as projected for phase 2 and the 5.5 million pounds of milk per day. However, these trips will spread out over the full 24 hours of the day and, thus, be expected to result in minimal additional impact on the roadway operations during the critical AM and PM peak hours. The future full build-out conditions will be evaluated in a subsequent traffic impact study to be completed for the City of Greeley.

TRIP DISTRIBUTION

Traffic to and from the site will depend upon the type of trip. Truck traffic will be regional and utilize US 85. Employee traffic will, in general, be local and utilize several routes within the City of Greely including US 85, 16th Street, and 8th Street. Trucks to and from the site will use the 13th Street & 1st Avenue entrance. If the US 85 & 13th Street intersection is allowed to continue to operate as full-movement and a signal is installed, all of the truck traffic will use 13th Street to access US 85. If the access control plan for US 85 is upheld and a right-in/right-out configuration is implemented for the US 85 & 13th Street intersection, then the majority of the truck traffic associated with the site will have to use 16th Street to access US 85. Geometrically, this may not even be possible for trucks to maneuver their way to 16th Street but for the purposes of analyzing a right-in/right-out scenario, it was assumed that trucks could access 16th Street.

The regional distributions for each of the vehicles associated with the proposed facility were developed based on information obtained by Leprino Foods as to the location of the local dairy farms, most direct access to the freeway for product distribution and the surrounding population from which the employment base will be derived.

Raw Milk Truck Traffic

- 80% to/from US 85 South
- 20% to/from US 85 North

Supply and Finished Goods Truck Traffic

- 90% to/from US 85 South
- 10% to/from US 85 North

Employee Traffic

- 50% to/from US 85 South
- 25% to/from US 85 North
- 10% to/from 16th Street West
- 5% to/from 16th Street East
- 5% to/from 8th Street West
- 5% to/from 8th Street East

The attached **Exhibit 4** shows the anticipated trip distribution for the proposed site while **Exhibit 5** and **Exhibit 6** show the project trips dispersed on US 85 for the right-in/right-out (RIRO) and full-movement signalized configurations respectively.

SIGNAL WARRANT ANALYSIS

The Federal Highway Administration's *Manual on Uniform Control Devices* (MUTCD) provides eight warrants for evaluation in determining whether an intersection should be considered for signalization. The warrants that were applicable based on the data available and conditions of the US 85 & 13th Street intersection include the following:

- Warrant 1—Eight-Hour Vehicular Volume
- Warrant 2—Four-Hour Vehicular Volume
- Warrant 3—Peak Hour
- Warrant 4—Pedestrian Volume
- Warrant 7—Crash Experience

The other three warrants are based on providing safety for a school crossing (Warrant 5), maintaining traffic progression within a coordinated signal system (Warrant 6), or for controlling traffic on the roadway network (Warrant 8). These warrants were not evaluated at this time as no school crossing was identified along the corridor, platooning of vehicles was not identified as an existing problem, and the roadway network was not listed as an issue at this time.

The MUTCD recommends removing minor approach right-turning traffic volumes from the calculation if a right-turn lane is present and the right-turning traffic enters the major street with minimal conflict. However, this reduction is not required and its use varies based on jurisdictional preference. Currently, the eastbound approach on 13th Street has a right-turn lane and a southbound acceleration lane onto US 85 resulting in 'minimal conflict.' The westbound approach does not have a lane specifically identified for right turns and does not have an acceleration lane on US 85. It is anticipated in the future, however, that

these will be required as a part of the Leprino Foods project. Therefore, the signal warrants were analyzed both with and without right-turn volumes when appropriate.

US 85 is posted at 45 mph, which results in the 70% factor being applied for Warrants 1, 2 and 3. Another factor to consider, which is not covered in the MUTCD, is the high percentage of heavy vehicles included in the existing and proposed traffic. All of the projected traffic from the future Leprino Plant on 13th Street will be trucks. For signalized intersections, when determining capacity, heavy vehicles are equated to passenger cars at a 2 cars equal one truck ratio (2:1). When considering the gap required on the major roadway for a heavy vehicle at a stop-controlled intersection, this car equivalent ratio becomes closer to 4:1. Therefore, with the high percentage of trucks anticipated for the minor street approach, both ratios were considered and evaluated as support in evaluating the signal warrants and in determining the basis for considering installation of a traffic signal at this location.

An evaluation of the past three years of accident data identified a significant amount of traffic accidents at the intersection of US 85 & 13th Street in 2005 when the Great Western Sugar plant was operating, but very few in the two subsequent years after the sugar plant had shut down. To meet Warrant 7 (Crash Experience), the intersection must experience five or more crashes within a 12-month period of types susceptible to correction by a traffic control signal. Additionally, the volumes at the intersection must meet the 80% volume requirements for Warrant 1A and 1B for eight hours in a day. Finally, the intersection must have had adequate trial of alternatives with observation and enforcement without reduction to the crash frequency.

The crash frequency at this intersection does not appear to be attributed to an enforcement issue and no trial alternatives with observation are known of. Of the seven crashes experienced in 2005, five of them could be corrected by a traffic control signal. Therefore, the only variable as to whether Warrant 7 is met for each condition is based on the volume requirement.

Table 4 below summarizes the signal warrant analysis results. As shown, at least one warrant is met for all of the conditions analyzed.

Table 4. Signal Warrant Analysis Summary

SCENARIO	SIGNAL WARRANT				
	Warrant 1 (Eight Hour)	Warrant 2 (Four Hour)	Warrant 3 (Peak Hour)	Warrant 4 (Pedestrian)	Warrant 7 (Accidents)
Existing	**Met**	**Met**	**Met**	Not Met	**Met**
Existing (without EB right-turn)	Not Met	**Met**	**Met**	Not Met	Not Met*
Future with Project (without EB right)	**Met**	**Met**	**Met**	Not Met	**Met**
Future with Project (without EB and WB right)	Not Met	**Met**	**Met**	Not Met	Not Met*
Future with Project (without EB and WB right; with 2:1 ratio of passenger cars to trucks)	Not Met	**Met**	**Met**	Not Met	Not Met*
Future with Project (without EB and WB right, with 4:1 ratio of passenger cars to trucks)	**Met**	**Met**	**Met**	Not Met	**Met**

*These conditions do not meet the volume required for Warrant 7 despite the intersection having sufficient accidents.
Source: Martin/Martin applying the signal warrants as described in the *MUTCD*.

As stated in the *MUTCD (Chapter 4C.01)*: "The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal." The signal warrant examination provided in this memorandum is intended as a step in the process of determining whether a traffic signal should be installed at the intersection. Research has shown that installation of a traffic signal can lead to certain types of collisions; therefore, a determination of whether to install a signal should not be based solely on the results of the warrants.

US 85 LEVELS OF SERVICE

Since the signal timings along the US 85 corridor were developed based on volumes from 2005 and new volume counts were collected in 2008, several scenarios were evaluated for comparison of the corridor operations. Intersection capacity analysis were conducted and level of service calculations were reported for five separate scenarios including the following:

1. Year 2005 with PBS&J volumes, signal timings and offsets
2. Year 2008 based on the existing counts from 2008 using PBS&J signal timing offsets
3. Year 2008 (existing) using optimized offsets for increased signal progression
4. Future with the first two phases of the project complete and a right-in/right-out configuration at US 85 & 13th Street
5. Future with the project and the first two phases of the project complete and a full-movement traffic signal at US 85 & 13th Street.

The capacity analysis is reported in terms of level of service (LOS), with LOS A indicating good operations to LOS F signifying congested, poor operations, and delay in seconds per average vehicle. The City of Greeley and CDOT both have indicated a preference for intersections to be designed to operate at LOS C or better, recognizing that a minor street movement or major street left-turn movement may at times operate at LOS of E or F during either the AM or PM peak hours. Both future scenarios were analyzed using the optimized offsets for the US 85 corridor, which operates as an actuated system assumed to adjust and serve future volumes as efficiently as possible. Traffic volumes for the future conditions are shown in the attached **Exhibits 7 and 8**.

Level of service at the subject intersections were calculated applying the methods from the *2000 Highway Capacity Manual* as implemented in *Synchro, Version 7*. **Table 5** shows the level of service at each of the intersections along US 85 for the various conditions.

Table 5. Intersection Level of Service

Intersection	Peak Hour	Year 2005 (PBS&J)		Existing (PBS&J Timing)		Existing (Optimized)		Future (RT_{in}/RT_{out})		Future (Signal)	
		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
US 85 & 5th Street	AM	B	10.1	A	4.0	A	4.8	A	4.8	A	4.2
	PM	B	14.8	A	6.7	A	7.6	A	7.6	A	7.4
US 85 & 8th Street	AM	B	10.6	B	14.0	B	18.0	B	18.6	B	18.0
	PM	B	14.6	B	15.9	B	19.5	B	19.9	B	19.1
US 85 & 13th Street	AM	-	-	D [2]	26.1	D [2]	26.1	B [1]	13.3	B [1]	10.1
	PM	-	-	E [2]	35.4	E [2]	35.4	B [1]	12.9	B [1]	11.4
US 85 & 16th Street	AM	A	9.4	B	11.6	B	12.2	B	15.7	B	14.5
	PM	B	14.3	B	14.8	B	14.7	B	18.6	B	17.0
US 85 & 18th Street	AM	B	13.3	B	12.4	B	12.6	B	12.6	B	12.0
	PM	B	16.0	B	13.5	B	13.4	B	13.7	B	12.7
US 85 & 22nd Street	AM	C	21.1	C	21.6	C	20.3	C	20.2	B	19.8
	PM	C	21.1	C	21.6	C	21.7	C	21.6	C	21.2

[1] Traffic control for 13th Street intersection is stop-controlled in the existing and future right-in/right-out conditions. A signal is assumed for one of the future conditions.

[2] One or more of the movements at this intersection is functioning at LOS F.

As shown in the table above, all of the intersections within the study area are functioning at LOS C or better, with the exception of the intersection of US 85 & 13th Street. All of the intersections meet the City of Greeley and CDOT standards for acceptable level of service and are anticipated to continue to do so with the addition of traffic from the first two phases of the Leprino Foods project. Based on the information shown in the table, the addition of the traffic associated with the Leprino Foods Plant and the installation of a traffic signal at 13th Street is not anticipated to significantly degrade the operations at any of the intersections along US 85 within the study area.

US 85 SIGNAL PROGRESSION AND BANDWIDTH

Signal timing and offsets for the coordinated signal corridor along US 85 from 22nd Street to 5th Street were developed by PBS&J as part of a signal coordination study in August, 2005. The previous work was conducted in Synchro, Version 6, which has since been updated to Version 7. For the actuated system, the timing plans consisted of establishing the cycle length, the signal phasing, the maximum green times for the various phases, the pedestrian timing, where appropriate, the yellow and all red clearance intervals, and the offsets between intersections. The signal timing and offsets recommended by PBS&J within the US 85 Signal Coordination Study were assumed to have been implemented and comprised the current operating conditions. PBS&J provided the Synchro model that was used to develop and included the signal timing plans to Martin/Martin Inc. for purposes of analyzing and reporting the progression for this network of signalized intersections.

In 2005, with PBS&J's volumes, the bandwidth for the 90th percentile condition was reported to be 36 seconds northbound and 16 seconds southbound during the AM peak hour and 21 seconds northbound and 24 seconds southbound during the PM peak hour. Utilizing the same timing and network offsets, the more recent 2008 volumes were entered into the model. The 90th percentile bandwidth increases slightly with the 2008 volumes. Since the volumes in 2008 were different than those in 2005, the signal offsets were re-evaluated to increase green time bandwidth through the system. By adjusting offsets, bandwidth

for the existing condition can be increased by as much as 55 percent during the AM peak hour and 75 percent during the PM peak hour.

These optimized offsets were used when evaluating proposed future conditions. Again, the system was evaluated for two future scenarios where the anticipated Leprino Foods plant traffic was added to the transportation system, one with a right-in/right-out configuration at 13th Street & US 85 and the other with a signal installed at this intersection. Both future scenarios showed a slight reduction in green bandwidths on US 85 compared to the existing optimized condition. **Table 6** below shows the anticipated green bandwidth on US 85 between 5th Street and 22nd Street for each of the scenarios that were evaluated

Table 6. Signal Progression along US 85.

Scenario	Northbound Bandwidth (seconds)		Southbound Bandwidth (seconds)	
	AM	PM	AM	PM
Year 2005 (PBS&J)	36	16	21	24
Year 2008 (PBS&J Timing)	39	21	22	33
Year 2008 (Optimized)	44	37	45	34
Future (Right-in/Right-out)	44	31	45	34
Future (Signal)	44	36	43	34

Source: Synchro, Version 7.

The information shown in Table 6 above is depicted graphically within **Exhibits 9 and 10**. The reported progression bandwidths show that the addition of the Leprino Foods Plant traffic are not anticipated to result in a significant impact to the progression along US 85, regardless of whether a signal is installed at 13th Street.

CONCLUSIONS/RECOMMENDATIONS

Leprino Foods is proposing to construct a cheese and whey manufacturing and processing plant at the location of the previously operating Great Western Sugar Plant in Greeley, CO. This facility is anticipated to function and operate much the same as the many other plants that Leprino Foods operates around the country. Leprino Foods selected Greeley for the city's location amongst dairy farms for the raw milk necessary to manufacture their cheese and proximity to Denver for distribution of the cheese. A direct and safe access to US 85 to accommodate the prevalent truck traffic that will operate at the Plant is critical for an efficient and successful operation.

While the site is in a good location and zoned for the land use necessary, there are many site constraints that have dictated the orientation of the building and, thus, the location of the service access for trucks. With this access located as an extension of 13th Street along the west side of the property, which is closest to US 85, the route between US 85 and the service entrance that provides the safest and least impacting connection is along 13th Street. This route is the safest by minimizing the interaction between trucks and the employees' and other passenger cars in the area until the trucks are on US 85. This route is the best for preserving the integrity of the roadway network by minimizing the turns required by the trucks on lower classified roadways such as 1st Avenue and 16th Street.

In order for the predominantly southbound trucks to access US 85, the addition of a traffic signal at 13th Street is prudent. The *US 85 Access Control Plan* has identified the 13th Street access as a high priority improvement intersection that should be minimized to a right-in/right-out configuration. This plan was prepared with minimal to no impact analysis to understand what a traffic signal might result in at this location and without knowledge that a substantial economic, employment and product generator such as a Leprino Foods Plant might be located with a need to utilize 13th Street in the future.

As part of this traffic study, the proper analysis and evaluation of the 13th Street access to US 85 has now been conducted. This evaluation included a signal warrant analysis of the US 85 & 13th Street intersection, a capacity analysis of the five existing signalized intersections along US 85 between 5th Street and 22nd Street plus the proposed 13th Street intersection, and a signal progression analysis of this US 85 corridor for the existing and both future configurations, with 13th Street as a right-in/right-out and a full movement traffic signal.

With the assistance of the City of Greeley, Leprino Foods is requesting that the US 85 Access Control Plan be amended to allow Leprino Foods to fund the installation of a traffic signal and any necessary improvements to provide the adequate auxiliary lanes at the intersection. The following results and considerations are offered in support of the amendment:

1. **Signal Warrants Met**—The conditions of multiple signal warrants are satisfied by the existing volumes and geometry at the intersection, and multiple signal warrants are anticipated to continue to be satisfied with the completion of the first two phases of the proposed Plant.
2. **Level of Service Maintained**—The intersection capacity analysis indicates that the City of Greeley and CDOT standards for level of service are satisfied and that there will be no significant decrease in the operations at the individual signalized intersections along the US 85 corridor as a result of addition of a traffic signal at 13th Street.
3. **Signal Progression Improved**—Overall, the signal progression analysis identifies an improvement over both the existing operations along the US 85 corridor between 5th Street and 22nd Street and compared to the right-in/right-out configuration with the addition of a traffic signal at 13th Street. The primary reason for the improvement with the addition of a 13th Street traffic signal compared to the existing conditions is a re-evaluation of the offsets. The primary reason for the improved operations compared to a right-in/right-out configuration is that the 16th Street intersection is currently the most restrictive location along the corridor and, without the traffic signal at 13th Street, more Leprino Food Plant project-generated traffic would be forced to use 16th Street as the only reasonable alternative to 13th Street.
4. **Signal Essential to Project**—In order for the trucks to safely and efficiently operate given the site layout and service access for the proposed project, connection to US 85 needs to be via 13th Street. However, in order for the predominantly southbound oriented trucks to safely access US 85 a traffic signal is prudent at the 13th Street intersection.
5. **High Priority Improvement Intersection**—The *US 85 Access Control Plan* identified the 13th Street access as a high priority improvement intersection and, while the recommended modification is not what was originally anticipated, the change has been shown to be an improvement that would have a funding source. In the ten years since the plan was developed, no improvement has been made for lack of funding.

Provided that the request for an amendment to the US 85 Access Control Plan is approved by the Committee, the next steps will be to prepare a CDOT access permit and conduct a complete Traffic Impact Study of the potential impacts of the proposed Leprino Foods Plant on the surrounding roadway network.

October 1, 2008

N

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Exhibit 1. Vicinity Map

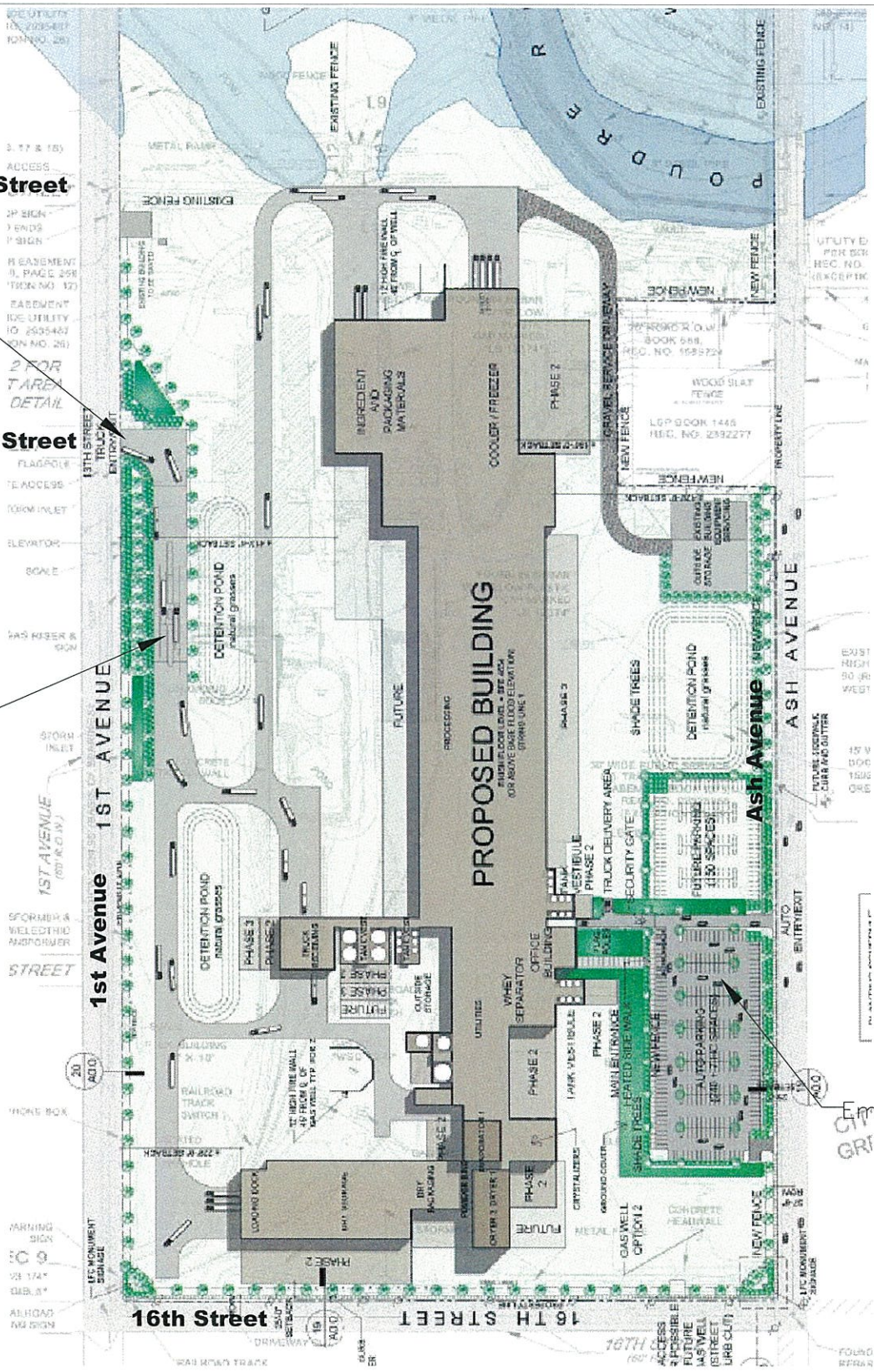

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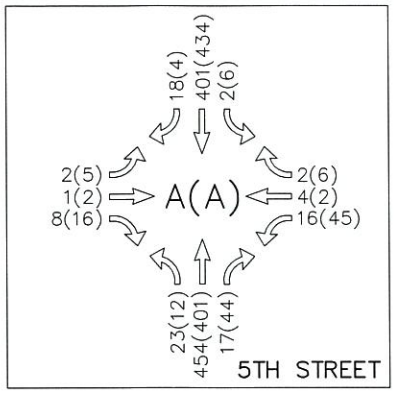
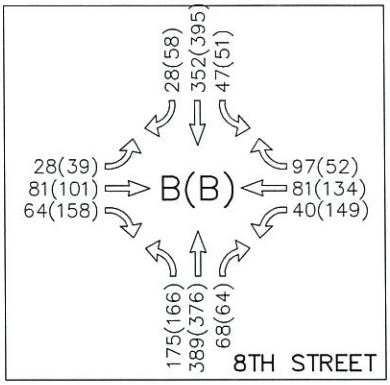
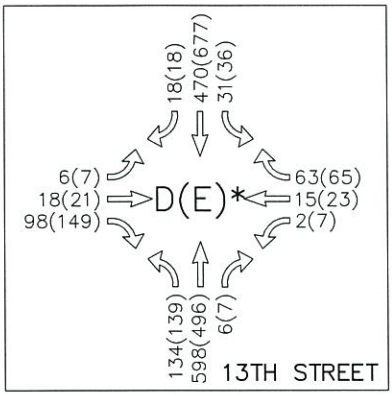
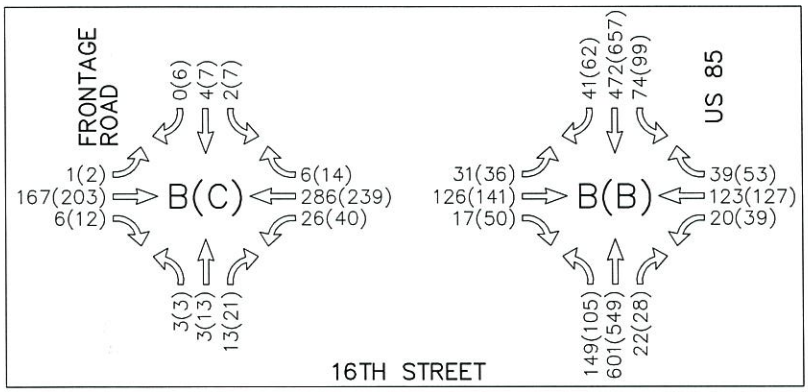
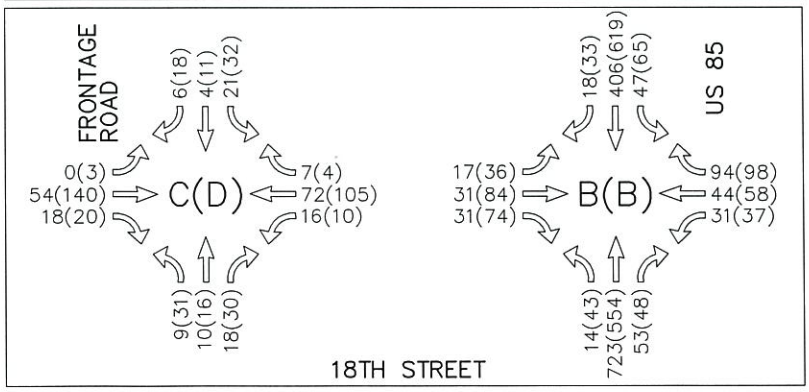
Exhibit 2.Preliminary Site Plan

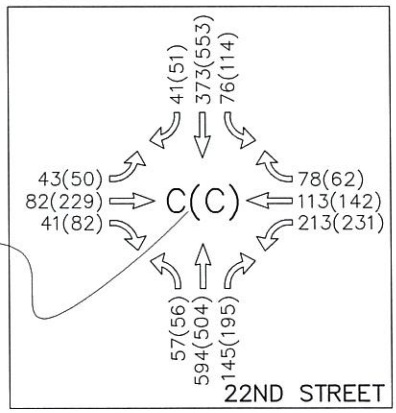












XX(XX) – AM (PM) Peak Hour

*One or more movement is operating at LOS F.

AM (PM) Level of Service

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Exhibit 3. Existing Traffic Volumes

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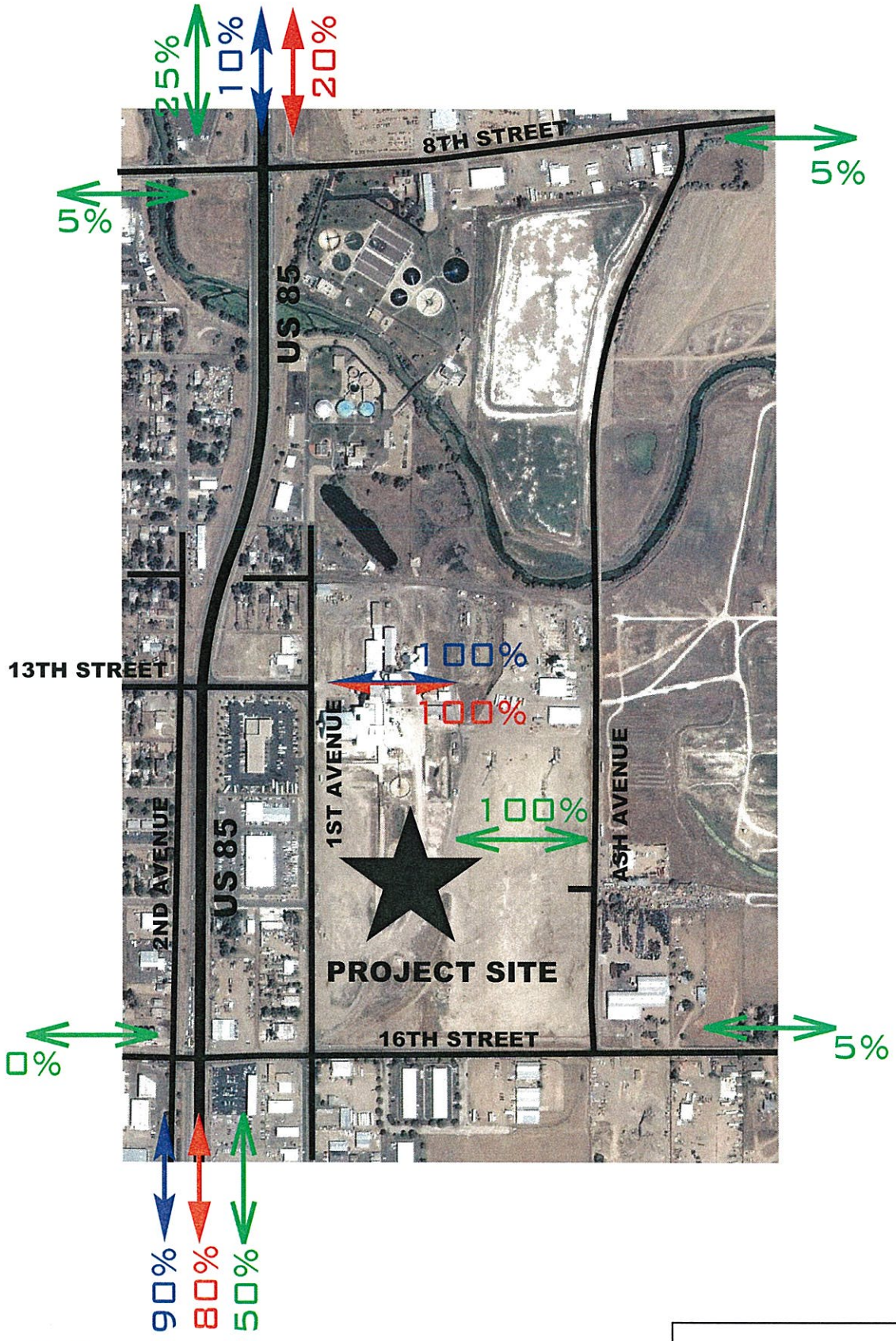

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← X% – Distribution Percentage (Employee Vehicles)

← X% – Distribution Percentage (Raw Milk Trucks)

← X% – Distribution Percentage (Supply and Finished Goods Trucks)

Exhibit 4. Project Trip Distribution

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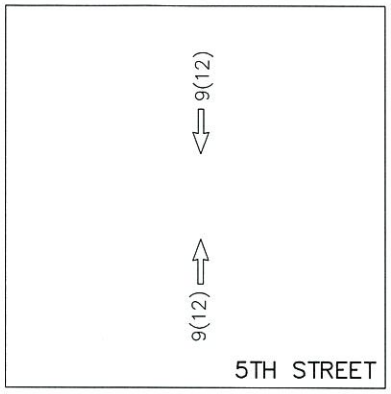

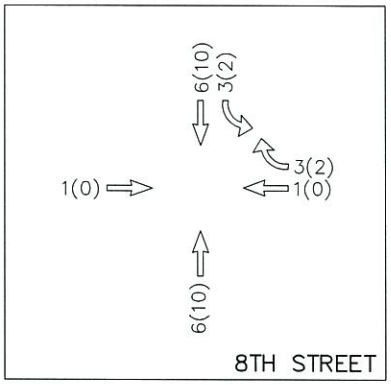

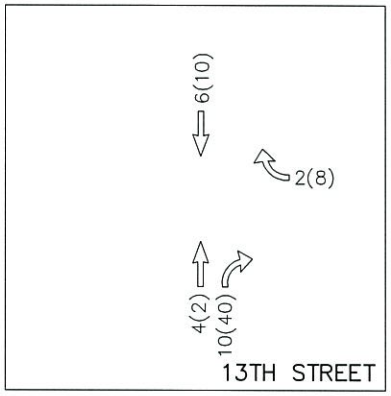

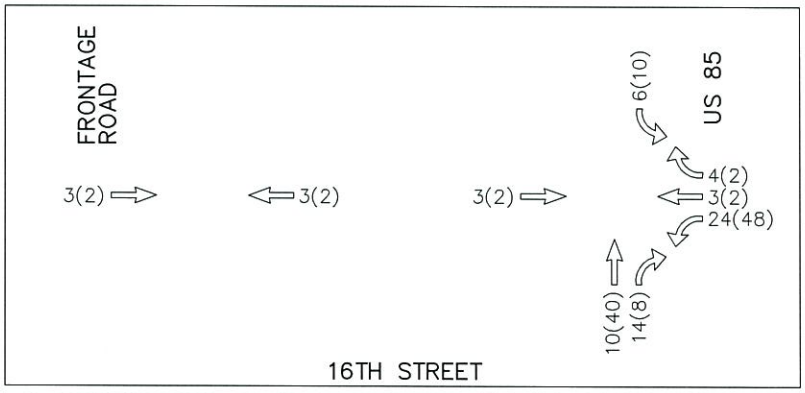

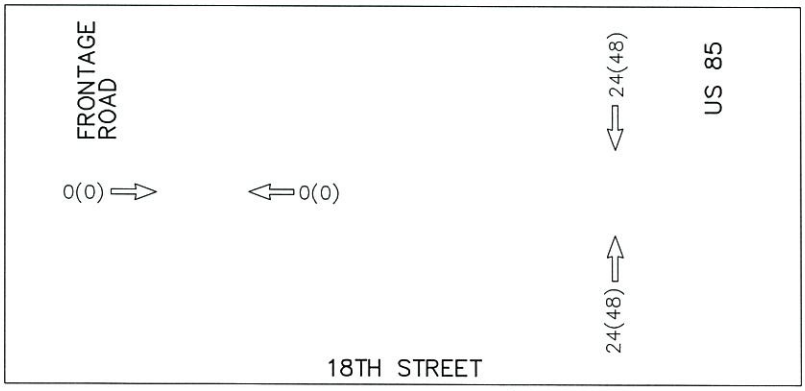

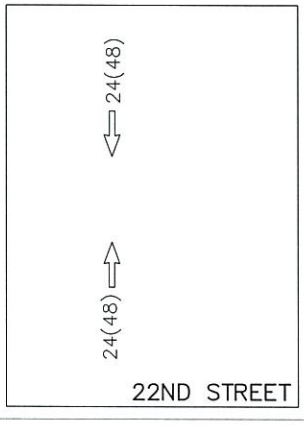

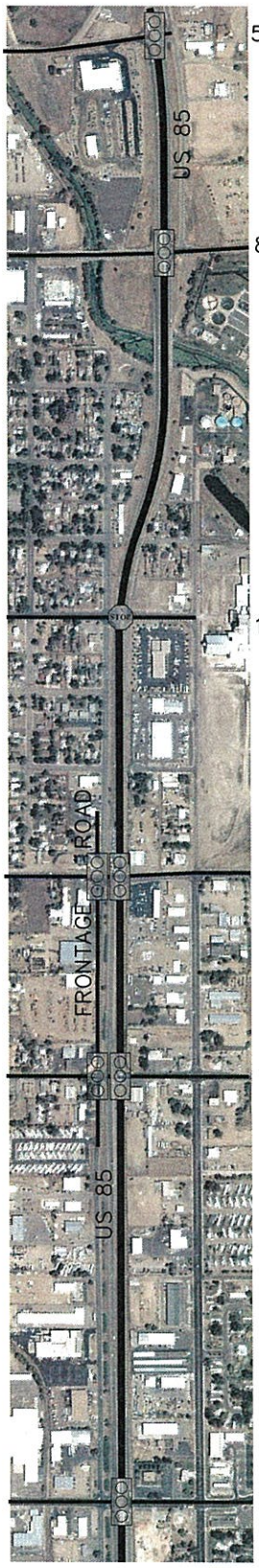

5TH STREET

8TH STREET

13TH STREET

16TH STREET

18TH STREET

22ND STREET

N

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October 1, 2008

XX(XX) – AM (PM) Peak Hour

Traffic Signal Control

Stop Sign Controlled

Exhibit 5. Site Generated Trips (R_{in}/R_{out} at 13th)

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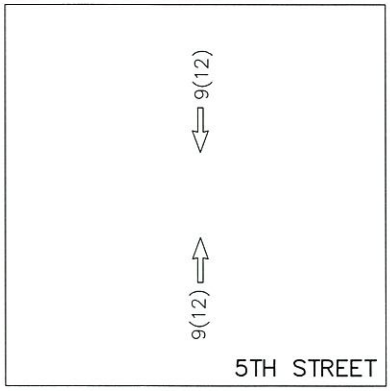

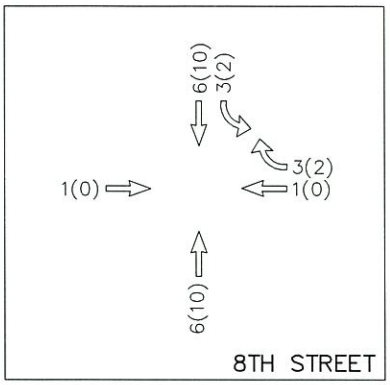

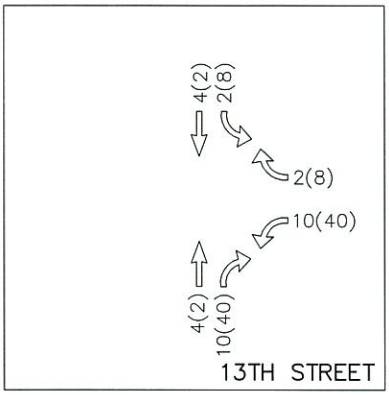

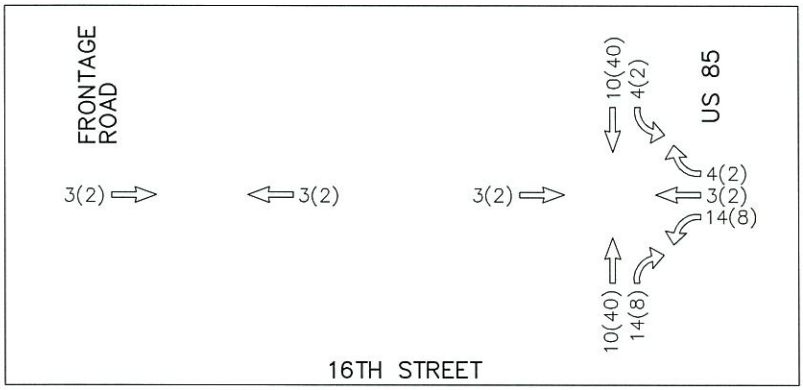

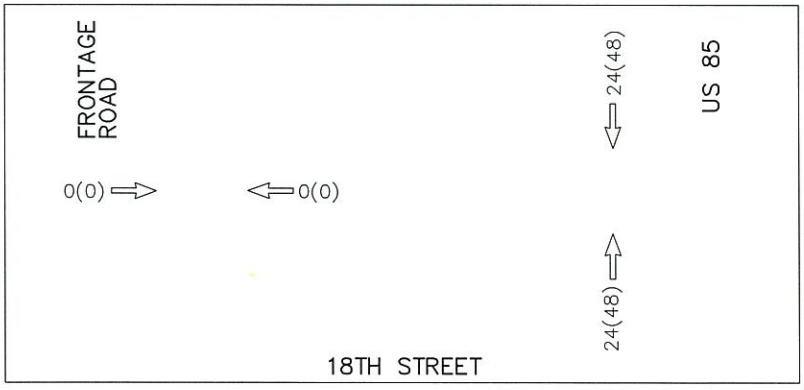

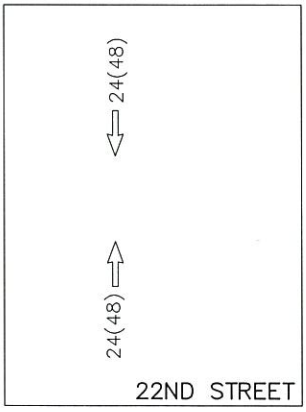

NOT TO SCALE
October 1, 2008

XX(XX) – AM (PM) Peak Hour

Traffic Signal Control

Stop Sign Controlled

Exhibit 6. Site Generated Trips
(Signal at 13th Street)

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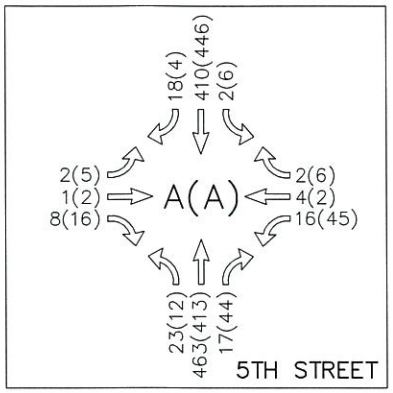

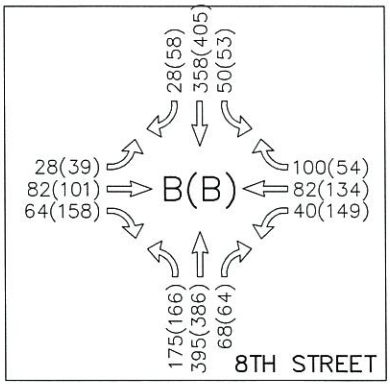

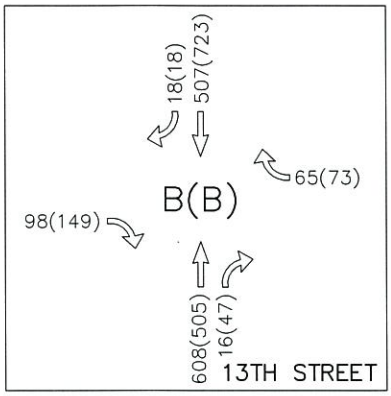

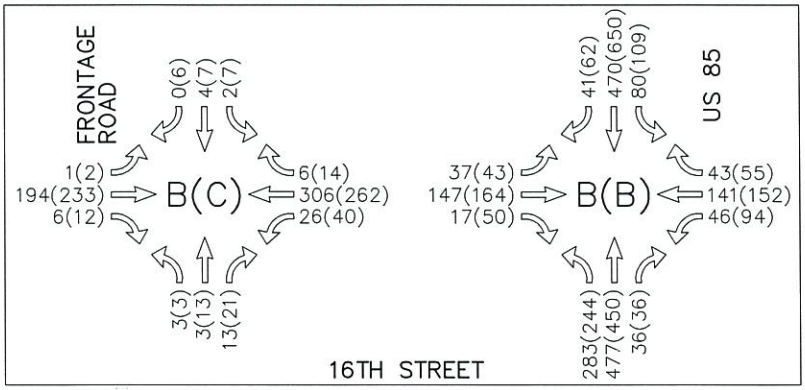

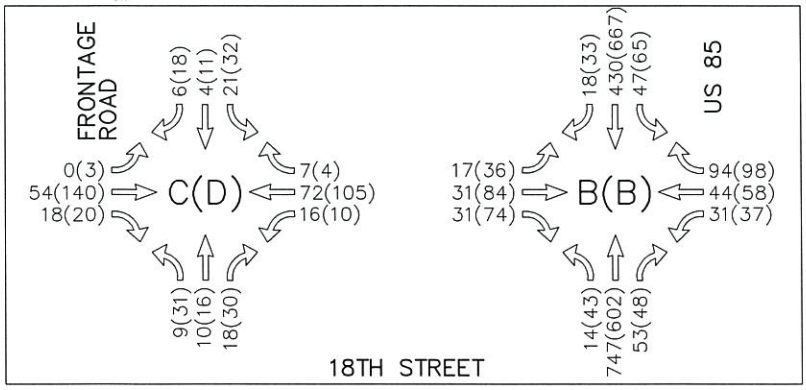

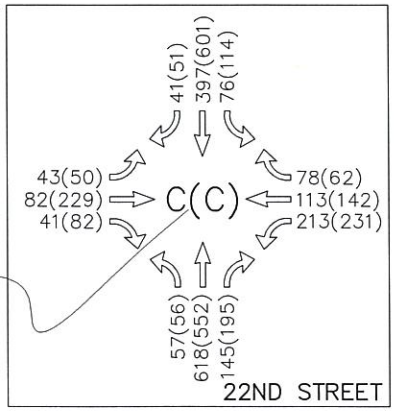

XX(XX) – AM (PM) Peak Hour

Traffic Signal Control

Stop Sign Controlled

Level of Service

Exhibit 7.Future with Leprino (R_{in} /R_{out} at 13th)

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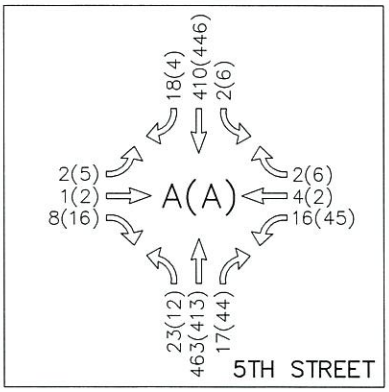

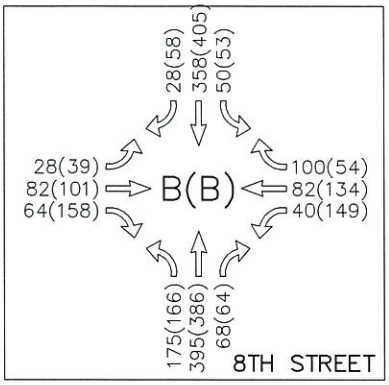

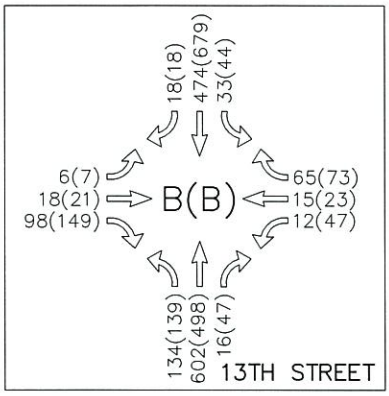

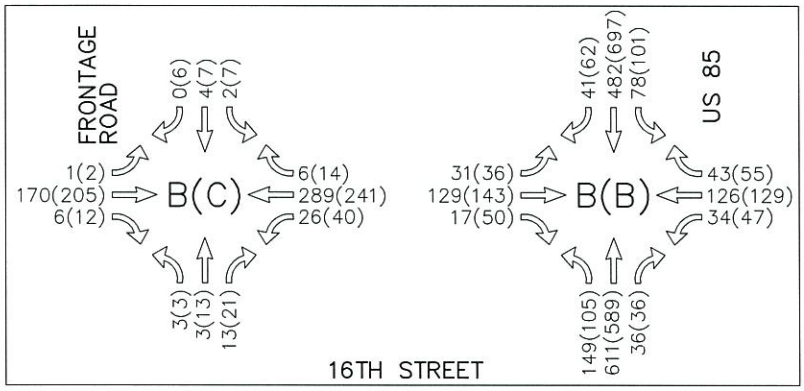

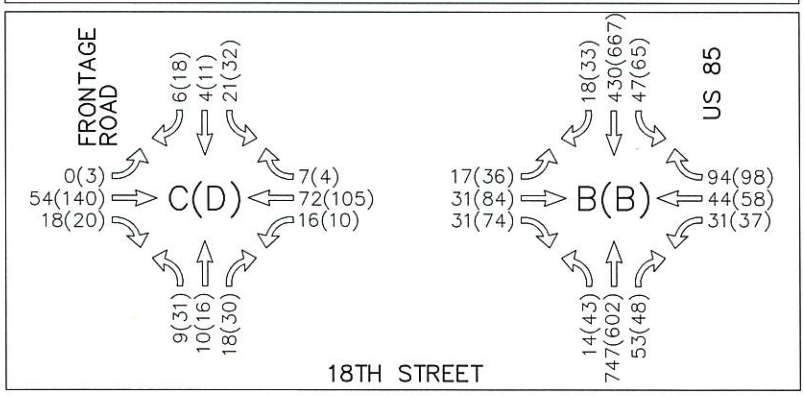

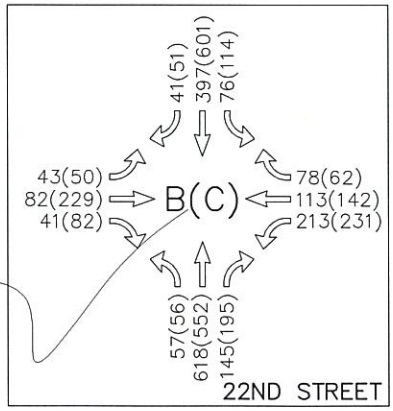

XX(XX) – AM (PM) Peak Hour

Traffic Signal Control

Stop Sign Controlled

AM (PM) Level of Service

Exhibit 8. Future with Leprino (Signal at 13th)

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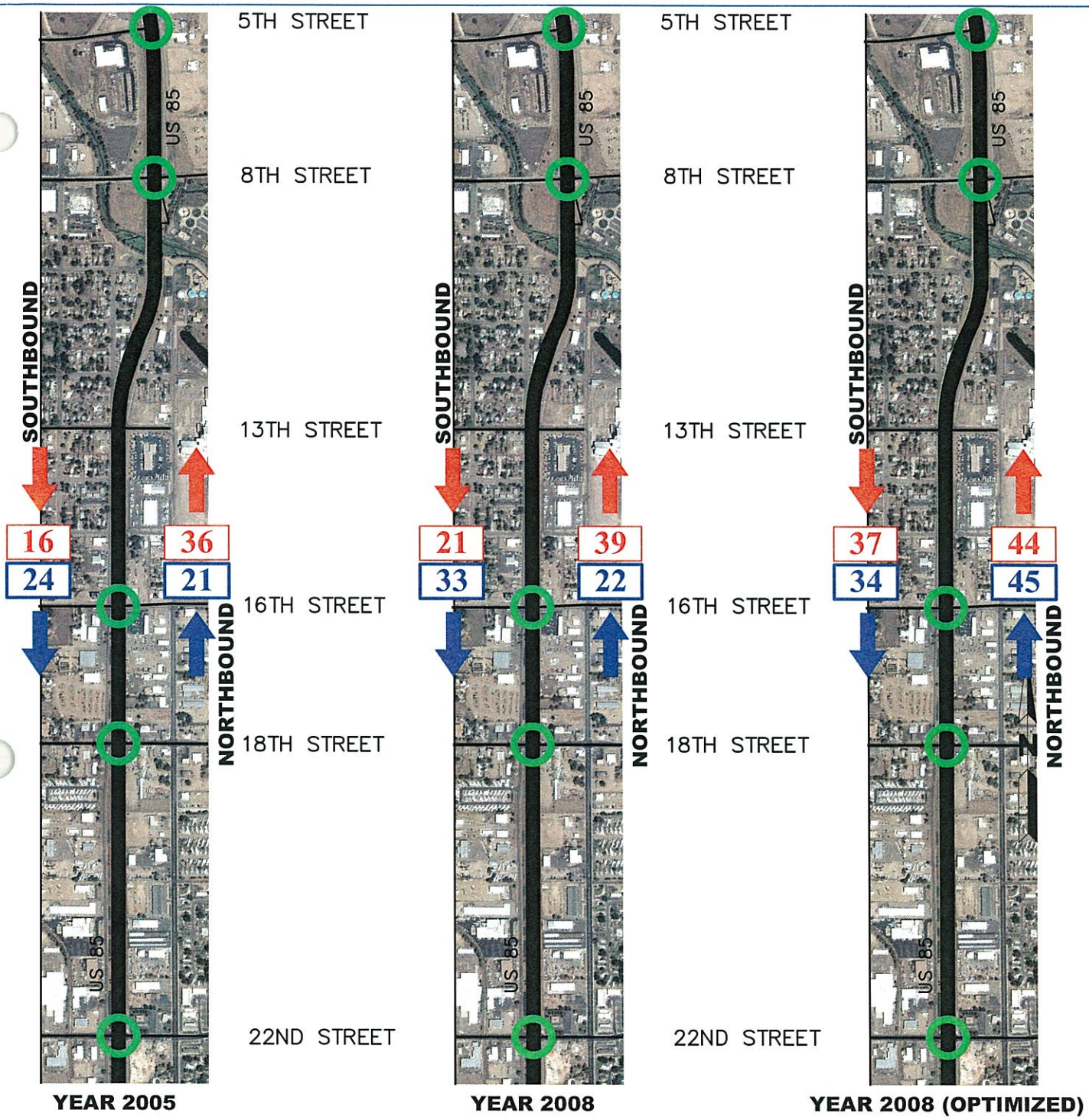

Traffic Signal Location

XX **AM Peak Green Bandwidth (seconds)**

XX **PM Peak Green Bandwidth (seconds)**

Exhibit 9. US 85 Existing Signal Progression

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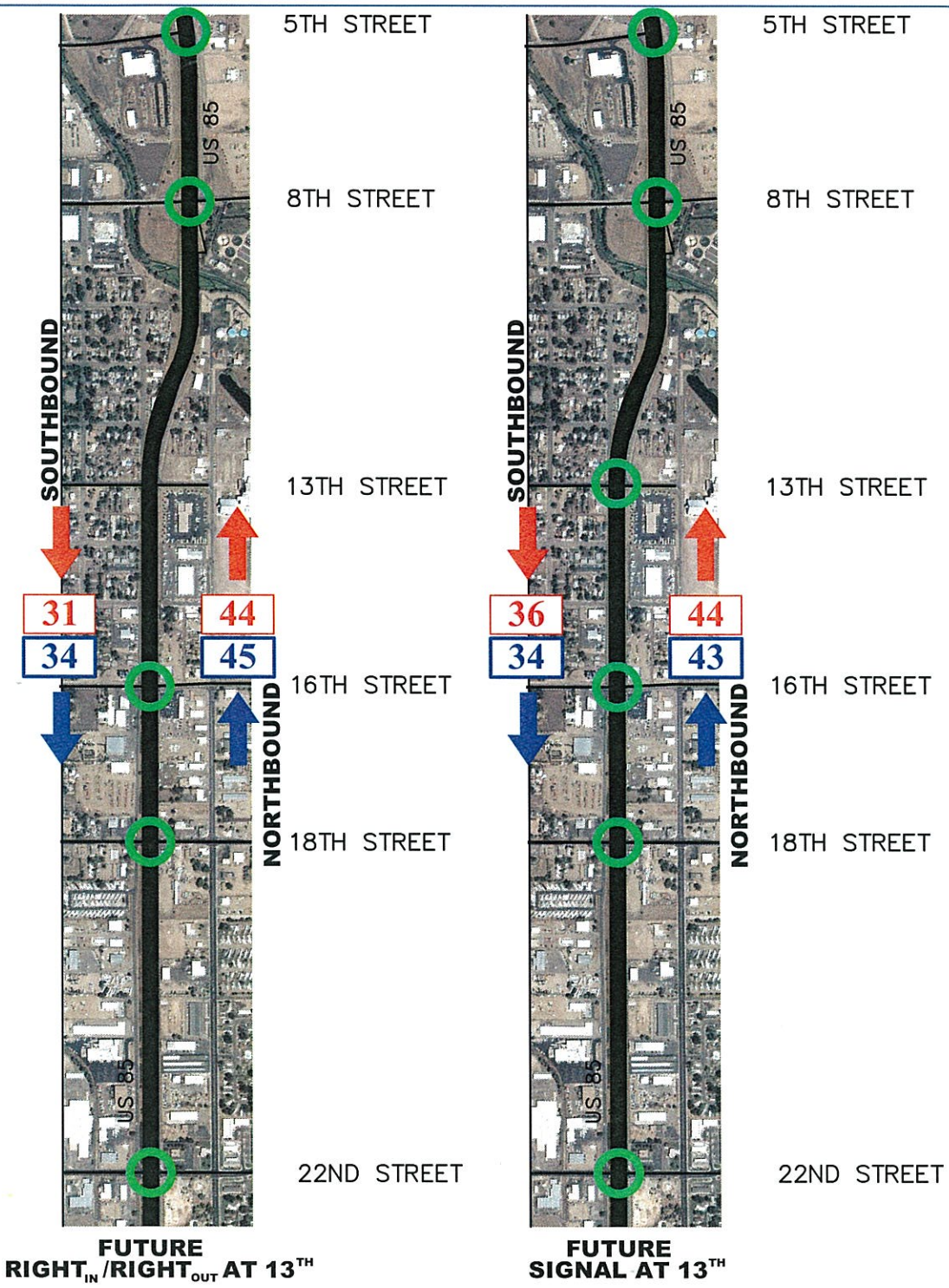

Traffic Signal Location

XX **AM Peak Green Bandwidth (seconds)**

XX **PM Peak Green Bandwidth (seconds)**

Exhibit 10. Future US 85 Signal Progression

NOT TO SCALE October 1, 2008

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